ACTA PARASITOLOGICA POLONICA
VOL. IX WARSZAWA, 30.VI.1961 FASC. 8

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The role of the silver foxes in the spreading of echinococcosis

Rola lisów srebrzystych w rozprzestrzenianiu echinokokozy

From the epizoötiological and epidemiological point of view, it is important to make up a list of definite hosts of the tapeworms *Echinococcus granulosus* (Batsch 1786) and *Echinococcus multilocularis* (Leuckart 1863). Many investigators have been interested in the problem whether the foxes can serve as definite hosts and what a part they play in spreading of the echinococcosis. The opinions on this question vary considerably and are even contradictory in some cases. For, the present author found *E. granulosus* in silver foxes during his experimental studies on these animals and thinks it necessary to discuss this problem more widely.

Such authors as Sprehn 1932, Neveu — Lemaire 1936, Stempell 1938, Mönnig 1949, Skrjabin 1951, Cameron 1952, Lubašenko 1952, Suić 1951, backed the opinion that *E. granulosus* could reach sexual maturity in the fox. In 1954, Grzywiński 1956 found *E. granulosus* in the domesticated foxes too; unfortunately he did not define the foxes more precisely. Cameron and Southwell (quoted after Dévé 1949), and Wetzel (quoted after Vogel 1957) succeeded in infecting foxes with *E. granulosus* under experimental conditions. However, the tapeworms did not reach sexual maturity in the intestine of foxes. Matoff et Jantscheff 1954 too infected 16 young red foxes under experimental conditions and they pointed out that *E. granulosus* lived in the small intestine of the animals for 25 to 35 days without reaching sexual maturity. On the grounds of these facts, the authors believed that foxes did not play any part in spreading of echinococcosis. Similar conclusions were drawn by Drezancić et Wikerhauser 1956 who infected two young red foxes in 1955 and found immature specimens of tapeworms in the foxes small intestine 104 days later. Siebold, Leuckart and Landois (after Dévé 1949), and Nosik 1956 failed to infect foxes under experimental conditions. Goette and Landois (after Dévé 1949) and Christiansen 1938 as well as Furmaga et Wysocki 1952 did not confirm *E. granulosus* in their work on the helminthic fauna of foxes.

Extremely significant in respect to the problem discussed is Vogel's work (1957). That author showed the differences between the species *Echinococcus multilocularis* (Leuckart 1863) and *Echinococcus granulosus*

(Batsch 1786) and established the taxonomic differential characters of the two species. Carrying out his experimental studies on 20 dogs, 5 foxes, 6 cats, 1 polecat, 1 badger and on many experimental and wild rodents infected by him with echinococs of human and animal origin, he concluded that domestic dogs, wolves, jackals, dingoes and coyotes could serve as definite hosts while wild or domestic ruminants, swines and human beings could serve as intermediate ones for *E. granulosus*. Vogel considered dogs, cats, foxes as definite hosts of *E. multilocularis* and on the other hand small field and forest mammalians (first of all *Microtus oeconomus raticeps, M. arvalis, Sigmodon hispidus, Mus musculus*) as well as human beings and primates as intermediate hosts. Vogel supposed that all of the tapeworms found in foxes by Neumüller 1933 and Mendheim 1955 in Germany, by J. G. Baer (unpublished data) in Switzerland, and by Brailsford (1926, quoted by Southwell 1927) and Sinclair 1956 in Great Britain, belonged to the species *E. multilocularis*. Also the tapeworms „*E. granulosus*" found by Cameron 1926 in foxes in the London Zoological Gardens and later more confirmed once in the same foxes by Ortlepp in 1934 and described by him as a new species *Echinococcus cameroni*, belonged to the species *E. multilocularis*.

It would follow from Vogel's conclusions that all the results of studies on *E. granulosus* should be called in question if the detailed morphologic data were lacking.

Petrov 1931, 1941 pointed out that all of the mature forms of the tapeworms found in dogs, wolves, foxes, polar foxes and jackals in the U.S.S.R. belonged to the species *E. granulosus*. But in his later work, 1958, in which he took under consideration the Vogel's 1957 findings as well as those of Matoff et Jantscheff 1954 and Drezancić et Wikerhauser 1956, he admitted that all of the tapeworms found in foxes and polar foxes in the U.S.S.R. (and classified as *E. granulosus*) belonged to the species *E. multilocularis*. Taking into consideration the work carried out by Rausch et Schiller 1956, and by Vogel 1957 who concluded on the rodents inability to get infected by *E. granulosus*, Petrov supposed that echinococcus found in the rodents throughout the U.S.S.R. and described in the works by Afanasjev 1941, Kiršenbiatov 1948, Spasskij, Romanov et Najdenova 1951, Vsevolodov 1953 and Dubinin 1953 (all after Petrov 1958) belonged to the species *E. multilocularis*.

It seemed that Vogel 1957 had definitively established the list of the definite hosts for both of the species discussed. However, studies carried out on foxes by Gorina 1959 and, recently, by the present author himself resulted in quite different findings, contrary to the works by Matoff et Jantscheff 1954, Drezancić et Wikerhauser 1956, and by Vogel 1957.

Gorina 1959 succeeded in infecting 4 young red foxes under experimental conditions and in obtaining mature forms of tapeworms *E. granulosus*. However, the authoress mentioned did not say whether she had taken into consideration the taxonomic characters given by Vogel 1957 in her definition of the tapeworms collected. Neither did she mention Vogel's work in the list of references quoted by herself.

The present author's observations are founded on his studies on the helminthic fauna of farm foxes. Nineteen silver foxes (*Vulpes vulpes domesticus* Haltenorth 1955) from a farm near Warszawa were examined in February 1959. Mature specimens of *Echinococcus* were found in 14 foxes. The extent of invasion was up to 77.7 per cent. The intensity of invasion varied within the range of 1 to 40 specimens.

The dissected foxes were 8—9 months old. These foxes were kept in a cage with a wire-floor and fed slaughter-house scraps, horse meat and fish. The foxes were spontaneously infected with echinococcus through the scraps. Very interesting was the fact that the tapeworms were not confirmed in 31 polar foxes (*Alopex lagopus*) from the same farm, though they were also young and fed the same food.

The morphological characteristics of the tapeworms collected were as follows: average length of strobila fixed in alcohol was 2.2 mm. The strobila consisted of three proglottides. The last proglottis was approximately 1.3 mm. long. The last but one proglottis was mature. The genital opening in mature proglottides was situated laterally in the middle of the edge while, in the last one, it lay beyond the middle, towards the end. There were 45 testicular vesicles, approximately 15 of them were situated frontally to the genital opening. The ovary was reniform in shape. There were many branches in the uterus. The morphological characters of the tapeworms collected were in accordance with the taxonomic features given by Vogel 1957 for the species *Echinococcus granulosus* (Batsch 1786).

In order to corroborate the present conclusions 11 white mice (*Mus musculus albino*) were infected with the mature proglottides collected from the foxes dissected. The mice were dissected within a period from 3 to 7 months following infestation. Yet, in none of them echinococcus could be found.

Taking into account the morphological characteristics and the data obtained by the experiment on mice, it was concluded that the tapeworms collected from the small intestine of the silver foxes belonged to the species *Echinococcus granulosus* (Batsch 1786).

Summing up the results obtained by Grzywiński 1956, Gorina 1959, and those of the present author's own studies, it can be confirmed that the red and silver foxes can serve as definite hosts for *E. granulosus* and they should be given consideration as the source of the spreading of echinococcosis.

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STRESZCZENIE

Autor omawia stan badań nad zróżnicowaniem morfologicznym i nad odrębnością żywicieli dwu gatunków tasiemca bąblowcowego: *Echinococcus granulosus* (Batsch 1786) i *E. multilocularis* (Leuckart 1863). Na podstawie badań własnych przeprowadzonych w farmach hodowlanych lisów srebrnych potwierdza sąd, że lisy te mogą być żywicielami ostatecznymi *E. granulosus* (Batsch).